I. C. 6937 APRIL 1937

DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES
JOHN W. FINCH, DIRECTOR

INFORMATION CIRCULAR

RECEIVED
MAY 14 1937
O. S. U. LIBRARY

MINING AND MILLING METHODS AND COSTS AT THE GLASS-SAND PLANT OF P. J. WEISEL, INC., CORONA, CALIF.

BY

EDMUND SHAW

TER THIS REPORT HAS SERVED YOUR PURPOSE AND IF YOU HAVE NO FURTHER NEED FOR IT, PLEASE RETURN IT TO THE BUREAU OF MINES, USING THE OFFICIAL MAILING LABEL ON THE INSIDE OF THE BACK COVER.

Generated on 2024-09-18 02:40 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

6937
I 1937

INFORMATION CIRCULAR

DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

MINING AND MILLING METHODS AND COSTS AT THE GLASS-SAND PLANT OF P. J. WEISEL, INC., CORONA, CALIF.[1]

By Edmund Shaw[2]

INTRODUCTION

This paper is one of a series being prepared by the United States Bureau ines describing mining and milling methods and costs at industrial mineral s throughout the United States. These papers are designed to disseminate ical information regarding the methods and equipment used. The cost tab- ions represent operating expenditures only and not total production costs. s recognized that publication of total production costs might, in many nces, cause embarrassment to individual producers as well as to the indus- as a whole. On the other hand, operating costs are essential to the tech- l discussion and study of the methods employed. The attention of the reader pecifically called to this differentiation in order that no misunderstanding e scope of the cost tabulations shall ensue.

P. J. Weisel, Inc., with office at La Habra and plant at Corona, Calif., e only local company that produces sand for the Los Angeles glass factories, ough silica sand for other purposes is produced in other parts of southern fornia and the adjacent portions of Nevada. The deposit at Corona consists oarse sandimbedded in a whitish clay and differs greatly from the other sits, which are fine-grained sandstone that must be crushed before it can reened and washed. The preparation of Corona sand has to be thorough and des grinding in tube mills, repeated washing and rinsing, removal of dust r separation, and magnetic separation of iron and other minerals. This res a plant with a complicated flow sheet. The first plant built did not a satisfactory glass sand, and many additions and changes were necessary. s thought that the present flow sheet will remain substantially unchanged a new plant is built. The design of a new plant would be simpler, but the ess would be the same.

Acknowledgment is due G. A. Van Valin, manager, for much of the information ined in this paper and for the explanation of the operation.

---

he Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6937."

he of the consulting engineers, U. S. Bureau of Mines.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

HISTORY AND DEVELOPMENT

The deposit was opened and developed by the present owners but under a different management. The plant was erected in 1925. It was not a success commercially because of the cost of experimentation necessary to determine the proper process required to make glass sand from the bank material. Success was attained after the plant was reorganized after many changes in methods and equipment had been made that reduced labor costs.

GEOLOGY

The sand is within an area of marine deposits of Eocene age shown on a geological map of Riverside County (fig. 1), copied from the 25th report of the California State Mineralogist, published in 1929. These marine deposits occupy an area about 25 miles long by an average of 4 miles wide, which extends northwest and southeast. It is bordered on the northeast by the Quarternary plain (through which runs the Santa Ana River) and plutonic rocks (in which there is a granite quarry) and on the southwest side by beds of Triassic limestone.

The deposit is on both sides of a valley through which the State highway from Corona to San Diego has been built. It is assumed that this was once a continuous deposit through which the valley was cut by erosion. The portion now being worked is in a long, low hill, and of this portion an area approximately 1,000 feet long and 800 feet wide has been proved by drilling. Only a very small area in proportion to the whole has been worked. The depth of the present working face is 100 feet, and the floor is in good sand. Drilling has shown that the depth varies with the surface contour from 40 to more than 125 feet. A conservative estimate, made from prospect drilling, places the reserve in this part of the deposit at 700,000 tons of recoverable sand. On the other side of the highway an irregular area, containing approximately 1,000,000 square feet, has been prospected by drilling 100-foot holes, none of which went through the sand. This was reported upon by an outside engineer as containing at least 2,000,000 tons of recoverable sand. There is very little overburden, and if a new plant is built it will probably be in this area across the road from the present plant. Parts of the area now being worked are covered with considerable overburden, but the amount is negligible where the present work is going on.

The deposit is not within the limits of a city or town. There are no homes nearby, and the nature of the operation is such that the nearest neighbor cannot be seriously damaged. The waste water from the plant is used to irrigate an orange orchard, and the solid wastes, mainly clay, pack hard and do not blow.

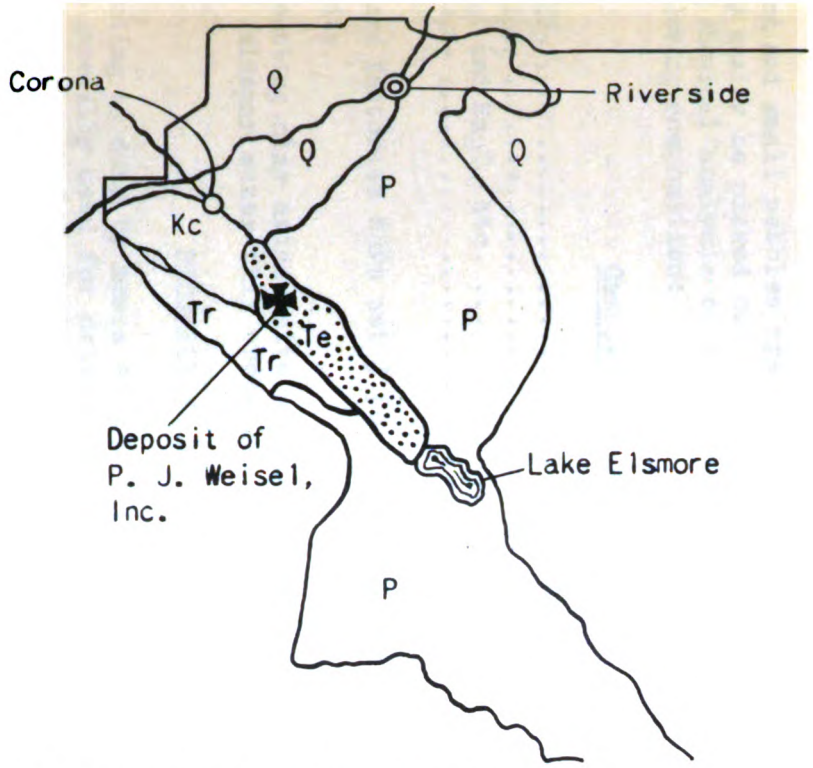
The topography is rolling--an area of low hills and rather flat valleys. The mountains of the Santa Ana Range are not far away. Toward Corona the road runs into the flat Quarternary plain and the Santa Ana River valley.

Character of the Material

The deposit consists of small pebbles and sand cemented by a whitish clay. Although a good-sized lump can be broken with the fingers, the cementing bond is sufficient to prevent the use of a power scraper for excavating the deposit without

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 02:44 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google



Q Quarternary. Sand, gravel, and clay
Te Eocenic. Marine deposits
Kc Upper Cretaceous. Sandstone, shale, and some lime
Tr Triassic. Heavy beds of limestone
P Plutonics. Granitic rocks

Figure 1.- Western end of Riverside County, Calif.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

t breaking it by blasting. As all excavation, including the floor, is in the deposit, the character of the surrounding rocks does not affect the in any way.

A mechanical analysis of the bank material is approximately as follows:

Sieve Analysis of Bank Material

	Percent
Clay and fine sand, -200 mesh	30
Sand, +200 to 1/4 inch	62
Pebbles, +$\frac{1}{4}$ inch to -$\frac{1}{2}$ inch	8

Pebbles larger than $\frac{1}{2}$ inch diameter occur in negligible quantity.

The sand and small pebbles are almost wholly silica, although grains of spar may easily be picked out of the coarser sizes. There is no complete rd of a chemical analysis of the bank material, but the finished glass sand the following composition:

Composition of Glass Sand

	Percent
SiO_2	94.5--96
Al_2O_3	2.5-- 3.5
K_2O and Na_2O, etc.	1.8-- 2.3
Fe_2O_3	.03- .04

The glass factories have set 3 percent Al_2O_3 and 0.05 percent Fe_2O_3 as imum limits.

The cementing clay dries white and is said to be nearly pure kaolin. The sence of feldspar makes this probable.

PROSPECTING AND EXPLORATION

Prospecting is done by means of a drill rig, designed and built at the plant, the type generally used for driving water wells. It is set on an automobile ssis, which is jacked up while drilling is going on, so that power can be en from one of the rear wheels. The bailer, made of a 12-foot length of ch well casing, has a shoe that serves as a bit. The tip is covered with ite (a hard alloy) to take the wear.

In prospecting the unmined area across the road the holes were set about feet apart one way, but not according to any particular pattern. Three were on the tops of hills, three in valleys, and three on the sides of hills. were put down 100 feet without going through the sand. No water was found in of the holes. Every time the bailer was emptied the driller threw in a few kets of water.

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

METHODS OF SAMPLING AND ESTIMATION OF TONNAGE

During prospecting samples were taken from the bailer every 10 feet, and some partial analyses were made on composite samples. No samples of the bank material are taken regularly. Samples of the finished product are taken regularly from the bins and tested for iron in the plant laboratory. The method employed is to fuse with an alkali, make a solution, and compare with a standard color solution. Other determinations are made in commercial laboratories in Los Angeles and Lancaster, Ohio. The dry weight of one cubic foot of bank material is assumed to be 100 pounds, for estimating purposes. Reserves are so large that no record of depletion as a percentage is kept, but occasional measurements are made of the quantity removed in a given time. All sieve testing is done with hand-shaken Tyler Standard testing sieves.

CHOICE OF MINING METHOD

Power-scraper loading was adopted because it was deemed to be the most economical method under local conditions for the tonnage to be handled. Originally the material was loaded and transported to the conveyor belt that fed the plant by scrapers drawn by tractors. This was expensive; the bill for repairs to tractors was about $200 per month, and the labor costs were high. For the comparatively small tonnage (140 tons per day to produce 100 tons of finished sand) the power scraper has been found to be very satisfactory as to both first and operating costs.

Mining is simplified by the fact that there is no dilution with waste and no need for selective mining; everything in the bank goes to the plant. No development is required, and the only plant transportation is by the scraper bucket.

MINING

Holes are drilled by electrically driven coal augers, which penetrate 4 fe per minute. They are set in two rows, at the toe of the bank face, which is 100 feet high and stands nearly vertical. The holes in the lower row are staggered vertically with those in the upper row as shown in figure 2. The lower holes are horizontal and are driven at the level of the floor, but th are slanted 45° from the line of the face. The upper holes are normal to the face, but pointed downward, so that the bottoms are at the floor level. All holes are 16 feet deep.

Augers are made of standard, 1½-inch, twisted steel of 2-inch gage. They are sharpened by cutting the point on the anvil to the right shape and slant without grinding. The points are hardened by heating to a cherry red and then plunging them into water. This has been found to produce the best wearing poi

Sixteen holes are loaded with 40 percent dynamite and shot at one time. No. 6 caps and fuse are almost always used for firing, but when the pit forema judges that simultaneous firing would be better because of the condition of th face electric detonators and a battery are used. All the details of drilling blasting are left to his judgment. The consumption of explosives averages 1/10 pound per ton of bank material brought down.

Generated on 2024-09-18 02:44 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

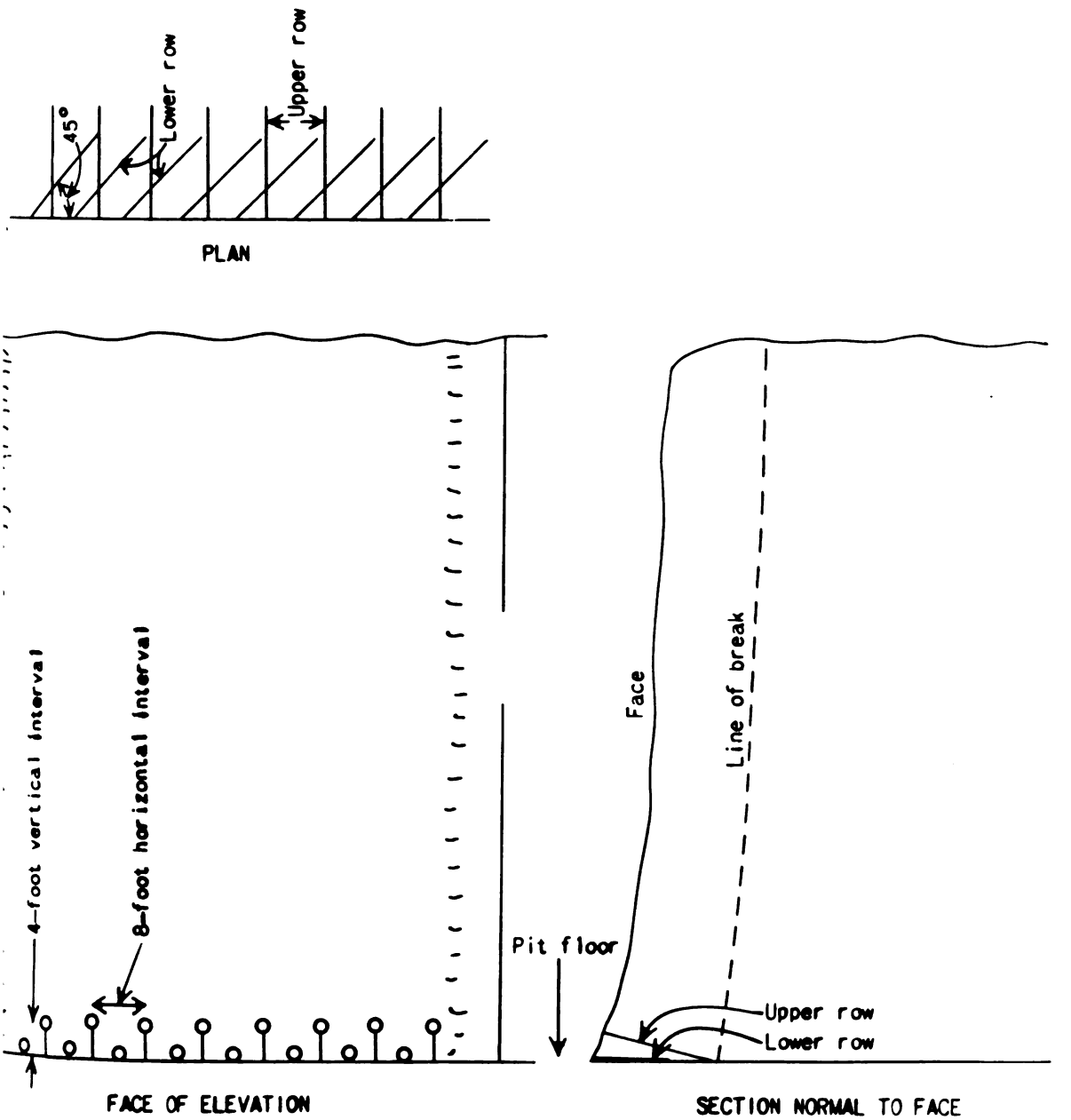


Figure 2.— Position and direction of holes in a 16-hole shot.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Recently blasting with vertical holes, put down with the prospecting drill described, has been tried. Holes were drilled 18 feet apart, 18 feet back ı the face, and were 90 to 125 feet deep, all holes being bottomed at the ıl of the floor. Each hole was loaded with 200 pounds of powder--two-thirds ıe bottom and one-third at the center of the hole. The results were so ısfactory that this method may be adopted for regular work, especially if ıction is increased.

LOADING AND TRANSPORTING TO PLANT

The material shot down is drawn to the belt that feeds the plant by ıs of a crescent-shaped, $\frac{3}{4}$-yard, power scraper bucket, operated by a hoist ı a 50-horsepower, 440-volt, alternating-current, induction motor. The ıent is supplied by a transmission line carried on poles. The inhaul rope $\frac{3}{4}$-inch and the outhaul 1/2-inch in diameter. The life of these ropes under ısent conditions has not been determined, but it is more than 1 year. The ed of the bucket is 300 feet per minute going out empty and 240 feet coming loaded. The two men who do the drilling and blasting also operate the aper and do all other necessary work in the pit, except that they may call others employed in the plant to help change sheaves and for other extra work.

At the inhaul end the scraper is drawn up a 10° incline built of steel rails discharge into the hopper that feeds the plant conveyor belt. The rails are 12 inches apart and serve as a grizzly, lumps that will not pass being broken hand. At present the bucket travels about 200 feet, and the discharge hopper about 225 feet from the hoist house, the total span being 425 feet.

The plant conveyor, described in detail later, is 250 feet long and has about to 3 inclination. It discharges into a rod grizzly, the first of the plant hines.

GRINDING

As the material is not closely consolidated it disintegrates in the prelimin- scrubbing and washing until everything passes a $\frac{1}{2}$-inch round-hole screen. ıce, no preliminary crushing is required and the necessary reduction can be made a tube mill 18 feet in length and 6 feet in diameter, outside measurements. feed is 60 percent solids and 40 percent water by volume. The tube mill is ıed with silex blocks, which reduce the inside diameter to about 5 feet and the ıside length to about 15 feet. The blocks are imported from Belgium and cost per ton at the plant, freight included. Danish pebbles Nos. 3 and 4, which approximately 3 and 4 inches in diameter, are used for grinding. The pebble ad approximates 23,000 pounds. They cost $20 per ton at the plant, and 200 ds is added each week. The life of the block lining has not been determined der present conditions, but it is estimated from measurements that it will last more than 10,000 tons.

Formerly an 8-foot double conical mill was used for this work, but this is w used as a scrubber for blast sand stock and is run without pebbles. Block ıings in this mill were worn out after grinding 4,000 to 5,000 tons.

38

Generated on 2024-09-18 02:41 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

SCREENS

The screens in this plant are numbered from 1 to 10 on the accompanying flow sheet (figure 3).

Screen 1

This is a trommel that receives the original feed after it has passed a revolving rod grizzly and a revolving scrubber. The trommel is an extension of the scrubber and is on the same shaft. It is 11 feet in length and 4 feet in diameter, and has $\frac{1}{2}$-inch round holes. The oversize is practically negligible in quantity. What little there is consists of clay lumps that fall to the ground and are taken away in a wheelbarrow and thrown into an old working. All that passes this trommel goes to washer 2, an inclined screw, which is followed by a paddle washer, No. 3, and then it goes to screen 2.

Screen 2

This is a 3- by 6-foot, double-deck, flat screen inclined 30°: It is hinged at the lower end and vibrated at the upper end by an eccentric shaft. The upper deck carries 6-mesh cloth and the lower 14-mesh. Oversize (plus 6-mesh) and undersize (minus 14-mesh) are washed in washer 5 and then go to the tube mill. The intermediate sizes (between minus 6- and plus 14-mesh), comprising raw material for blast sand, go to the double conical mill through washer 4.

Screen 3

This is a 3- by 6-foot inclined screen, resting on the ends of flat wooden springs, vibrated by an unbalanced pulley 600 times per minute. It is set at the highest point of the plant and receives the blast-sand stock after it has been washed in washer 6. The feed is lifted to it by elevator 1. The screening medium is 30-mesh wire cloth, and the undersize goes by gravity to one of the glass-sand washers (No. 11) below it. The oversize (blast-sand) goes to a drainage bin and then to the drier if it is to be dried. Some of it is sold in a damp state.

Screens 4 and 5

These are 3- by 6 feet and of the same type as screen 2 except that they are single-deck screens. They are in parallel with screen 6, and all three are covered with 30-mesh wire cloth and are fed from a revolving distributor. The three are the main plant screens for separating the glass sand from the discharge of the tube mill. The oversize, after passing screens 7 and 8, is returned by gravity to the tube mill. Screens 4 and 5 operate at 600 vibrations per minute.

Screen 6

This screen was designed and built by Robert Rawson, the plant foreman, his purpose being to design a screen that had no whipping motion and that would be easier on the screen cloth. In this he was successful, the brass wire cloth having about twice the life on this as on the other screens. When the screen was designed this brass cloth cost $8 per screen and its life was about 10 days

Generated on 2024-09-18 02:44 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

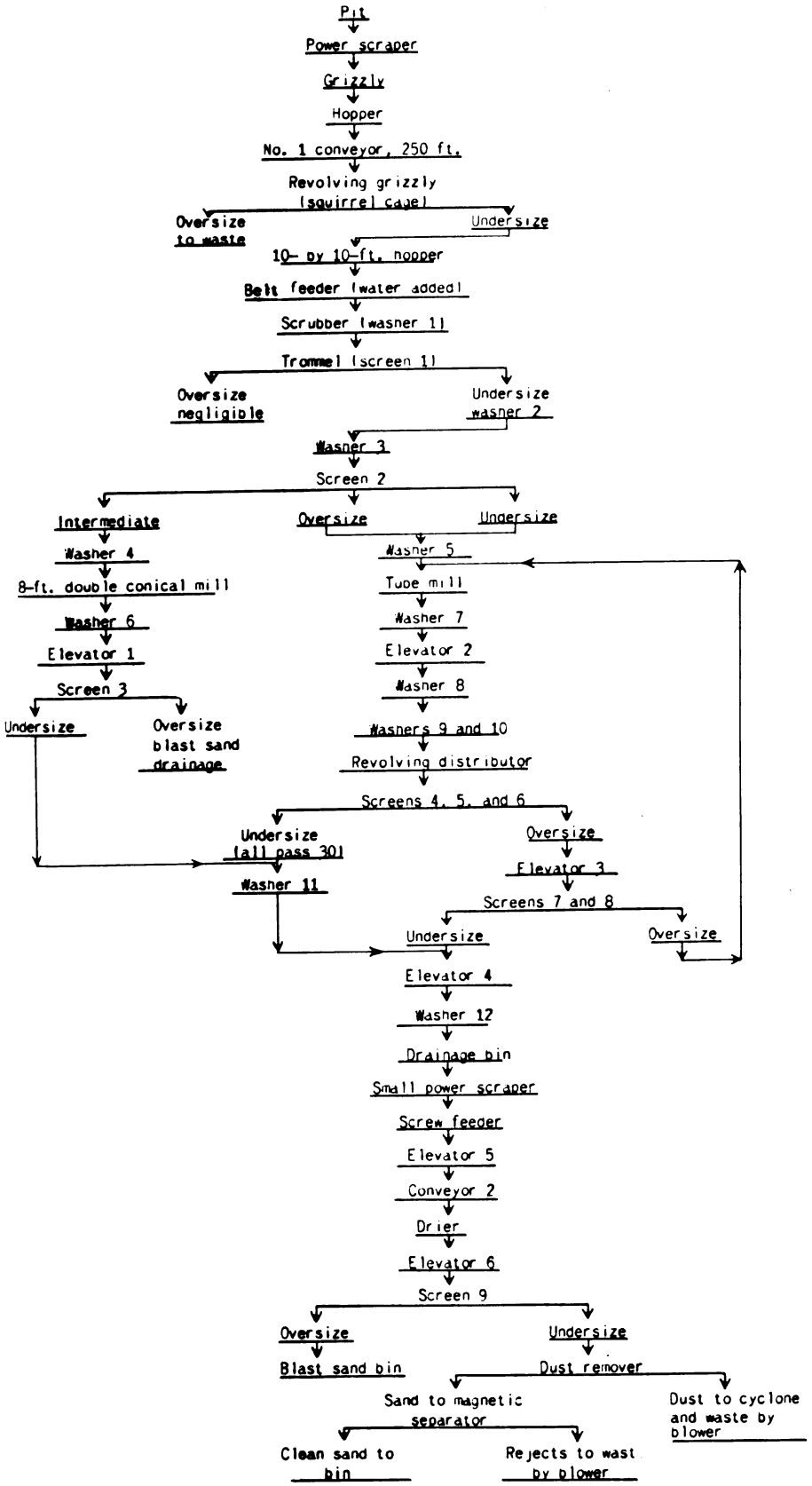
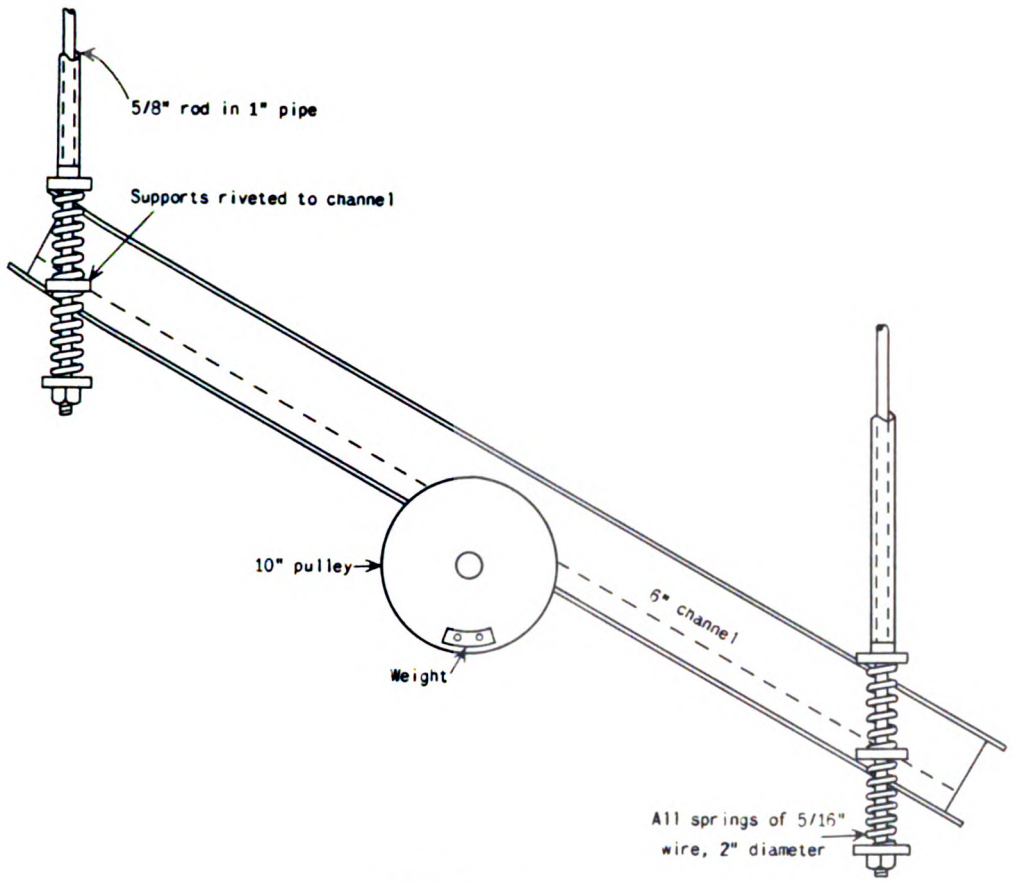
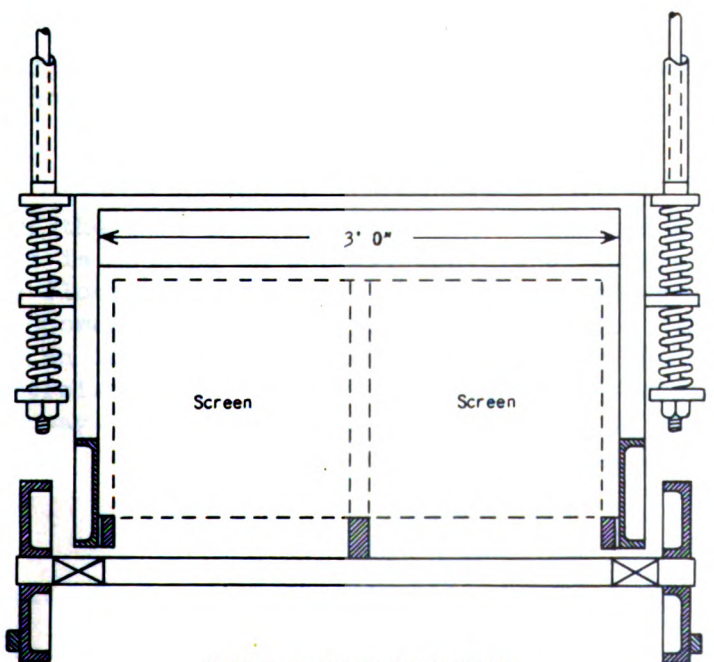


Figure 3.- Flow sheet of silica-sand plant of P. J. Weisel Inc.

Generated on 2024-09-18 02:47 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



SIDE ELEVATION



SECTION ON CENTER LINE OF PULLEY

Figure 4.– Rawson screen.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

eriments with stainless-steel cloth have shown it to be much cheaper because life is more than twice that of the brass cloth. Tests had not been completed n this was written.

The screen is set at the same angle as the others--30° from horizontal. corners of the frame rest on four spiral springs, which are at the bottoms the 4 rods by which the screen is suspended. On the same rods are four other ral springs set to resist upward motion, just as the lower springs resist nward motion. The frame is vibrated 720 times per minute by a belt-driven ft that carries two unbalanced pulleys. The amount of vibration is varied changing the weights that throw the pulleys out of balance. The construction this screen is shown in figure 4.

Screens 7 and 8

These are 3- by 6-foot electrically vibrated screens of the type that rates the cloth by a centrally located magnet and armature without vibrating frame. They are covered with the same 30-mesh wire cloth that is used on eens 4, 5, and 6. Screens 7 and 8 are set in parallel and are fed with the rsize of 4, 5, and 6, which is elevated to them by elevator 3, thus putting se two screens in series with the other three. The oversize goes back to tube mill by gravity; the undersize joins the undersize of screens 4, 5, and rom washer 11 to elevator 4 and is elevated to washer 12.

Screen 9

This is a vibrating screen of the same type as screens 7 and 8. It is fed h the hot material from the drier by means of the chain-and-bucket elevator 6. oversize always goes to the blast-sand bin, whether blast sand or glass sand being treated. The undersize goes to the dust remover and magnetic separator then to the clean-sand bin. The purpose of this screen is only to keep reign matter and accidental oversize out of the products, so it is covered with arger-mesh cloth (no.16) than the other screens.

Screen 10

This screen is of the same type as no. 2 and nos. 4 and 5, vibrating 600 es a minute, but it is mounted on a frame that is on wheels so that it can be ed anywhere on the floor below the bins where the trucks are loaded for delivery. drive is a 2-horsepower induction motor attached to the supporting frame. undersize goes to an inclined portable belt conveyor, which discharges into truck, and the oversize, usually small in amount, is shoveled into a wheel- row to be wheeled away. The purpose of the screen is to remove foreign matter l accidental oversize, but sometimes it is used to split blast sand into two es.

CONVEYORS

There are two belt conveyors in the plant, and a portable conveyor used in car loading.

Generated on 2024-09-18 02:47 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Conveyor 1

This conveyor brings the feed from the pit to the plant. It has a 24-in belt, is 250 feet long, center to center of pulleys, and runs at a speed of 1 feet per minute. It is supported on a trestle at an inclination of approxima 1 to 3. The lower end takes the feed from the hopper under the rail grizzly, which serves as a track for the power scraper. This is in a pit below the g ground level. The belt passes over the trestle, out of the pit, and discha to the "squirrel cage" (rod grizzly), which is above the main feed hopper. T belt runs on three-roll troughing idlers with standard, greased, babbited be which have been found to give better service than some types of antifriction idlers that were tried and that became filled with sand and locked. Some id have been in service 10 years.

Conveyor 2

This conveyor feeds the drier. It is a 12-inch belt, 30 feet long cent to center of pulleys, and handles about 6 tons per hour. The feed is draine sand that is lifted to it by elevator 5. The amount of feed is controlled b screw feeder that discharges into the elevator boot.

Portable Conveyor

This is a 12-inch belt conveyor on a frame that is carried on wheels an is 32 feet long, center to center of pulleys. It is driven by an induction motor mounted on the frame. The type is the ordinary commercial portable co veyor used for loading coal at retail yards and for many other industrial pu

ELEVATORS

The plant has five bucket-and-belt and one chain-and-bucket elevators. These are numbered from 1 to 6 in the flow sheet. All are of the centrifuga discharge type. All but no.6 handle pulps with fairly high moisture content

Elevator 1

This elevator has a 36-foot lift and a speed of 250 feet per minute. T belt is 10 inches wide and the buckets are 6 by 6 by 9 inches. It is inclin about 5° from the vertical; all the other elevators are vertical. Its feed the blast-sand stock that has been scrubbed in the double conical mill and washer 6, and it lifts this to screen 3.

Elevator 2

This has a 26-foot lift and a speed of 250 feet per minute. The belt i 10 inches wide and the buckets are 6 by 6 by 12 inches. It receives the tub mill discharge after it has been washed in washer 7 and raises it to washer

Elevator 3

This has a 20-foot lift and a speed of 250 feet per minute. The belt i 10 inches wide and the buckets are 6 by 6 by 9 inches. It lifts the oversi of screens 4, 5 and 6 to screens 7 and 8, for rescreening.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Elevator 4

This has a 20-foot lift, a speed of 250 feet per minute, and the same size and buckets as elevator 3. It lifts the undersize of screens 4, 5, 6, 7, to washer 12.

Elevator 5

This has the same lift, speed, and sizes of belt and buckets as nos. 3 and 4. lifts the drained sand, fed to it by the screw feeder, to conveyor 2, which the drier.

Elevator 6

This is a chain-and-bucket elevator of 30-foot lift with 5- by 5- by 5-inch ts. It lifts the hot sand from the dryer to screen 9. This elevator has a housing; all the others have wooden housings.

GRIZZLIES

There are two grizzlies. The first is in the pit and receives the scraper- t discharge. It is made of 90-pound rails, 20 feet long, and is set at 10° from horizontal to provide a track on which the scraper may be drawn the hopper that feeds conveyor 1. Only the part above the hopper acts as zzly, and the sand is allowed to build up to the rails outside of the r. This grizzly may be rotated in line with the direction of the scraper's

The other grizzly, called a "squirrel cage" in the plant, is a revolving grizzly made of old 1½-inch pump rods fastened to circles of flat iron on rs, by which they are held to a central shaft. The speed is 18 revolutions inute. The oversize is lumps of clay that go to a waste pit in an old g. Besides taking out these lumps of clay, the grizzly is useful to p lumps of partly cemented material so that it may be screened and washed e scrubber-trommel below. The grizzly is 12 feet long and 4 feet in ter and the rods are set with 4-inch clear spaces. The discharge falls tly into a 10- by 10-foot hopper.

WASHING EQUIPMENT

The Washing equipment includes a revolving scrubber, four "paddle washers" are really scrubbers, as they have no overflow), one inclined screw washer, nkey-motion" washer, two rake-type classifiers, three drag-belt classifiers, a 10-foot thickener for washing fine sands.

Washer 1

The first washer is the revolving scrubber, 4 feet in diameter and 5 feet inclined 1½ inches per foot and held by spiders on the same shaft as the el that follows it and to which it is attached. It is a cylinder of steel e on which are riveted "lifters" that lift and turn the material as it passes gh. The outlet is baffled a little to hold some water and feed in the

Generated on 2024-09-18 02:42 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

scrubber. The feed comes from the hopper above (below the rod grizzly) thro a 12-inch by 6-foot screw feeder. About 150 g.p.m. of water is added, this being the overflow of the 10-foot thickener, which receives the overflows of all the washers in the plant following the tube mill. The regular rate of f is 140 tons, dry weight, of solids per 8-hour day.

Washer 2

This is a factory-made inclined screw washer, a 16-inch screw conveyor a trough about 10 feet long, set at 18° from horizontal, and running at 18 r It receives the undersize of the trommel (screen 1), which has been washed i the scrubber, and sends it to washer 3. The overflow of this washer contain more clay and fine sand than the overflow of any other washer. It goes to a 16-foot thickener, first passing over a 7-foot cone in which coarser partic settle, to be clarified for use in the mill.

Washer 3

This is one of four paddle washers, all of which were designed and buil at the plant. They are something like log washers in appearance but are set horizontally, and have flat blades between the inclined blades that cut thro and urge the pulp along (as in a log washer). The purpose of these flat bla is to break lumps of clayey sand that may be formed by the pressure of the screws against the moving mass. All the paddle washers have blades of the s size and type, 13-inch radius, which are set on a 1-15/16-inch shaft. The d is by a chain and sprocket connection to a jack shaft and pulley and the spe is 65 r.p.m. The length of the paddle washers varies. Washer 3 is 12 feet These paddle washers have been found to give better results on this difficul material than any form of washer or scrubber that has been tried. The cons tion is shown in figure 5.

Washer 4

This is another paddle washer of the same dimensions and speed as wash

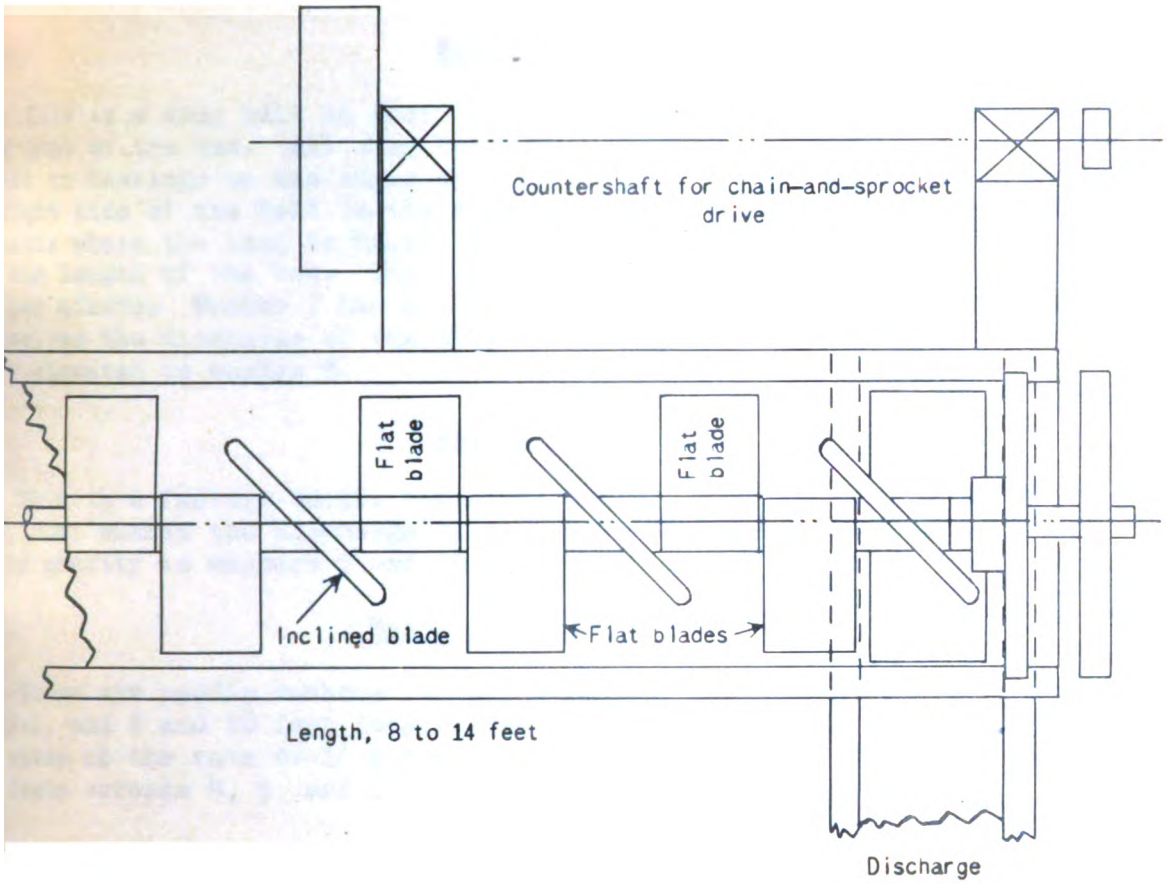
Washer 5

This is called the "monkey-motion" washer because the linkage that mov the rakes that pull out the sand and raises them on the return has a peculi motion. It was designed and built at the plant. The washer is 16 feet lon has 24-inch rakes, and is run at 32 strokes per minute.

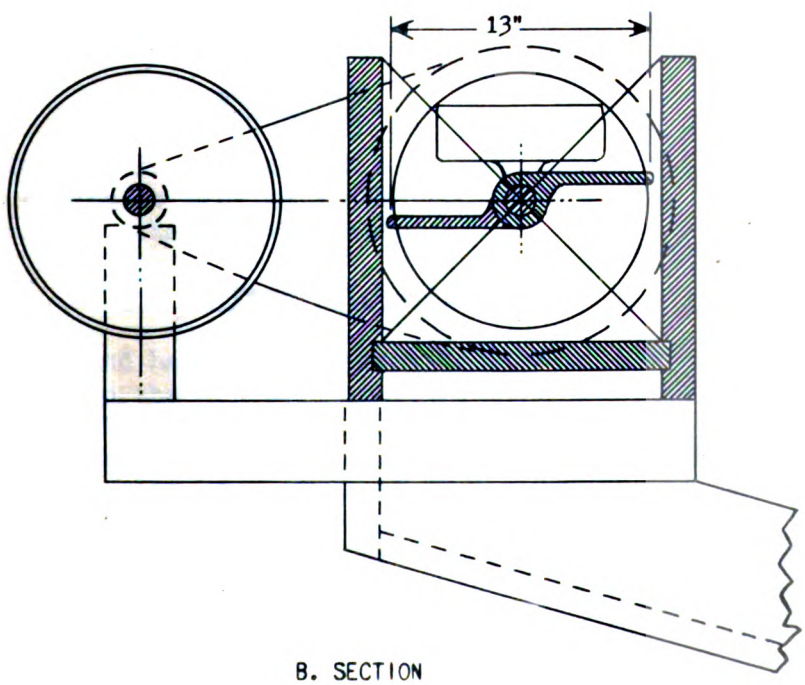
Washer 6

This is a factory-built, rake-type washer, 16 feet long, with 32-inch blades. It washes the discharge of the double conical mill (blast sand) an its product goes to elevator 1 and screen 3.

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



A. PLAN



B. SECTION

Figure 5.- Paddle washer.

Generated on 2024-09-18 02:40 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Washer 7

This is a drag belt 16 feet long, the length given for all these washers ng that of the box. All drag belts were made at the plant. Both pulleys set in bearings on the edges of the box so both are out of the water. tight side of the belt is the digging side, which is not the usual practice plants where the load is heavy; and the inclination is about 10°, varying h the length of the box. The overflow is at the end and the speed is 48 t per minute. Washer 7 has a 10-inch belt which carries 18-inch flights. receives the discharge of the tube mill and its product goes to elevator 2 is elevated to washer 8.

Washer 8

This is a factory-built, rake-type washer, 16 feet long, with 32-inch es, that washes the discharge of washer 7. The discharge from washer 8 s by gravity to washers 9 and 10.

Washers 9 and 10

These are paddle washers (or scrubbers) of the type described, set in allel, and 8 and 10 feet long, respectively. The pulp from these is diluted h water at the rate of 10 g.p.m., and then goes to the revolving distributor t feeds screens 4, 5, and 6.

Washer 11

This is a drag belt 14 feet long with a 10-inch belt and 18-inch flights. takes the undersize of screens 3, 4, 5, and 6 and delivers it to elevator 4, ch discharges to washer 12. Washer 11 has overflows on three sides instead only at the end.

Washer 12

This is a drag belt 14 feet long with a 10-inch belt and 24-inch flights. s wider than the others to provide a greater settling area because it ives the fine sand from the 10-foot thickener.

The 10-Foot Thickener

This is 4 feet deep and has a flat spiral instead of the usual blades to g the settled solids to the center discharge. The speed is $3\frac{1}{2}$ r.p.m. this and the 16-foot thickener (described on page 12) were originally fitted rakes, and both have shown better settling and dryer discharge since the ds were put in. The solids from this 10-foot thickener go to a 5½- by ch spiral pump, which lifts them to washer 12. The overflow is pumped by inch centrifugal pump to the scrubber trommel (washer 1), as described.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

PUMPING

Figure 6 is a flow sheet of the water-supply system.

All fresh water comes from a well 82 feet deep and is raised by a deep well turbine pump of 500 g.p.m. capacity to a 10,000-gallon storage tank, whic is 1/2-mile distant from the pump and 1/4-mile from the plant. The usual tan water level is 117 feet above the lowest floor of the plant.

The water comes to the plant through a 6-inch pipe that terminates in a 6-inch vertical column extending from the bottom to the top of the building. It has the following outlets: A 3-inch line that supplies 20 g.p.m. to the washer that receives the tube-mill discharge; a second 3-inch line that supplies 120 g.p.m. to drag belts 7, 11, and 12 and one rake classifier, no. 8; a third 3-inch line that supplies 500 g.p.m. to the sprays on screens 4, 5, 6, 7, and 8; a 1½-inch line that supplies 10 g.p.m. of water to the revolving distributor; and a 1½-inch line that supplies 50 g.p.m. of water to screen 3.

For clarifying the plant water there are two thickeners, the 10-foot thickener described and a 16-foot thickener, which is 4 feet deep. The latter has a flat iron spiral (instead of rakes), which revolves once in 4 minutes and 40 seconds. This receives the overflows of all the washers that precede the tube mill. They flow to a sump, from which they are pumped by a 5½- by 8-inch spiral pump and pass through a 7-foot cone to remove heavy solids.

The solids from this thickener are mostly clay, with some fine sand and mica. They run by gravity to a settling sump, which is part of an old workin Here the solids settle hard and the water runs to an orange orchard below, where it is used for irrigation. Occasionally the solids are dug out with a small, home-made, cableway scraper and are stacked in a pile. This disposal of the tailings is paid for by the owner of the orange orchard and is not charged to sand production.

The overflow of this thickener goes to a high-speed, 1½-inch piston pump which discharges into the clear water line.

DRYING AND DUST REMOVING

The washed sand from washer 12 goes to drainage bins and is drawn to the boot of elevator 5 by a home-made drag or scraper. This is a flat plank with plow handles. It delivers the sand to a screw conveyor 9 feet long with 9-in diameter flights. The trough has an open top and is kept filled by the scrap so that the screw delivers a uniform feed to the elevator, which in turn deli to the 30-foot conveyor belt that feeds the drier. The feed may be varied by changing the pulleys that drive the screw feeder.

The drier is of the direct-indirect type, 20 feet long and 6 feet in di It uses 33 cubic feet per minute of natural gas and usually delivers 6 tons hour of dried sand, the output being 75 to 80 tons per day. The remaining p tion is sold damp for polishing, plastering, and other industrial purposes. There are no available data from which the efficiency of the drier may be calculated. The feed is estimated to contain 8 to 10 percent moisture, and moisture can be detected in the product by the time it has passed the dust r and magnetic separator.

Generated on 2024-09-18 02:48 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

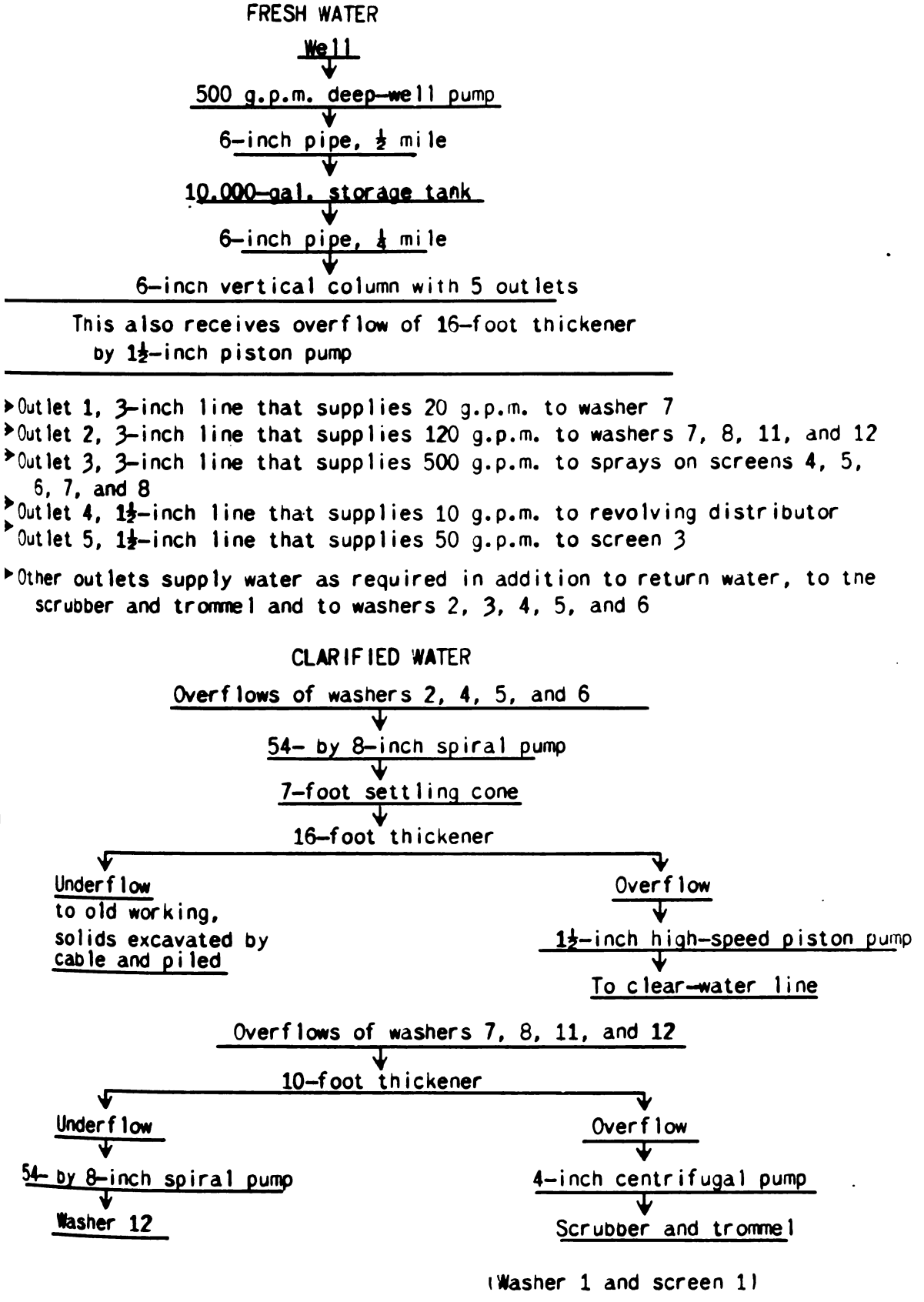

FRESH WATER
Well
500 g.p.m. deep-well pump
6-inch pipe, ½ mile
10,000-gal. storage tank
6-inch pipe, ¼ mile
6-incn vertical column with 5 outlets
This also receives overflow of 16-foot thickener by 1½-inch piston pump
Outlet 1, 3-inch line that supplies 20 g.p.m. to washer 7
Outlet 2, 3-inch line that supplies 120 g.p.m. to washers 7, 8, 11, and 12
Outlet 3, 3-inch line that supplies 500 g.p.m. to sprays on screens 4, 5, 6, 7, and 8
Outlet 4, 1½-inch line that supplies 10 g.p.m. to revolving distributor
Outlet 5, 1½-inch line that supplies 50 g.p.m. to screen 3
Other outlets supply water as required in addition to return water, to the scrubber and trommel and to washers 2, 3, 4, 5, and 6
CLARIFIED WATER
Overflows of washers 2, 4, 5, and 6
54- by 8-inch spiral pump
7-foot settling cone
16-foot thickener
Underflow
to old working,
solids excavated by cable and piled
Overflow
1½-inch high-speed piston pump
To clear-water line
Overflows of washers 7, 8, 11, and 12
10-foot thickener
Underflow
54- by 8-inch spiral pump
Washer 12
Overflow
4-inch centrifugal pump
Scrubber and trommel
(Washer 1 and screen 1)

Figure 6.- Water flow sheet.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The dried sand is elevated by a chain elevator (no. 6) to a 16-mesh, rically vibrated screen (no. 9), which removes accidental oversize and gn matter. The undersize goes to the dust remover, which serves also as ler. This dust remover was designed by Mr. Rawson, the plant foreman, and uilt at the plant. It is a box 6 feet long and 3 feet wide, two pyramidal rs forming the bottom. There is a flap between the two that is hinged at ottom so that it may be thrown over to cover either hopper, according to er glass sand or blast sand is being dried. Chutes lead from the hoppers e magnetic separator and blast-sand bins.

The feed comes from elevator 6, which takes the sand directly from the , which has its feed controlled by a screw feeder; hence the quantity gt uniform. It goes into a small hopper over a feed roller that spreads to a thin sheet. This falls in front of a screened opening in the end of the The box is under suction, which draws air through the screened opening hrough the falling feed, removing dust and also cooling the sand. The end of the box is reduced to a point, to which is attached a 4-inch pipe cted to a blower that furnishes the suction and blows the sand to a cyclone a waste pile.

A sample of the waste, which did not include the finest dust that escaped the cyclone exhaust, had the following sieve analysis:

Sieve Analysis of Dust Removed

Mesh	Percent
Retained on 30	0.8
Pass 30, on 60	7.5
Pass 60, on 80	7.8
Pass 80, on 100	23.1
Pass 100, on 150	34.3
Pass 150	26.5
	100.0

The sizes above 100-mesh were almost wholly mica, and there was some mica e smaller sizes.

The glass sand flows by gravity from the dust remover to the magnetic separator. is a commercial machine of the type that employs a closed magnetic circuit. lectric magnets, set in groups of three, terminate in pole pieces that are ed to receive soft-iron rollers about 6 inches in diameter. On the other of these is a soft-iron frame, also grooved at top and bottom to receive the rollers. Adjusting screws make it possible to vary the gap between the frame he rolls. This frame acts as an armature and completes the magnetic circuit, g magnetic fields in which the rolls revolve. This magnetizes the rolls, t on the neutral line between the magnets and the soft iron frame. At that the surfaces of the rolls lose their magnetism until they have passed it and nder the influence of the magnets or the armature frame again. There are sets of magnets, rolls, and frames set vertically, so that the sand flows the highest, which serves as a rougher, to the lowest, from which finished is discharged.

Generated on 2024-09-18 02:42 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The feed flows over the rolls in a thin stream, from which the magnetic minerals are collected by adhering to the rolls. When the neutral point is reached these minerals drop off and go to a box, from which they are drawn by the suction of a blower similar to that used for handling the waste from the dust remover. No cyclone is needed to settle this waste for almost all the du has been removed. It is allowed to pile up in the open. A sample taken from the pile had the following sieve analysis:

Sieve Analysis of Magnetic Separator Rejects

	Percent
Pass 30, on 40 mesh	24.3
Pass 40, on 60 mesh	45.6
Pass 60, on 80 mesh	10.7
Pass 80, on 100 mesh	10.2
Pass 100, on 150 mesh	6.8
Pass 150	2.4
	100.0

With a pocket magnifier the following minerals were noted in the rejects: Mica, (both biotite and muscovite), garnet, dried clay in fine grains, dark si grains, and metallic iron that was presumably abraded from the pipes and the p of washers with which the sand came in contact while passing through the plan

STORAGE, DELIVERY, AND MISCELLANEOUS

The sands ready for shipment, whether damp or dried, fall by gravity into storage bins, which will hold about 10 days' run. They are supported on posts above a concrete floor that forms a truck driveway. The ordinary way of loadi however, is for the truck to take the undersize of portable screen by means of a portable conveyor. These have already been described.

The truck takes the sand to a railroad siding where the company has hoppe for car loading. Most shipments are made by rail.

PERCENT EXTRACTION

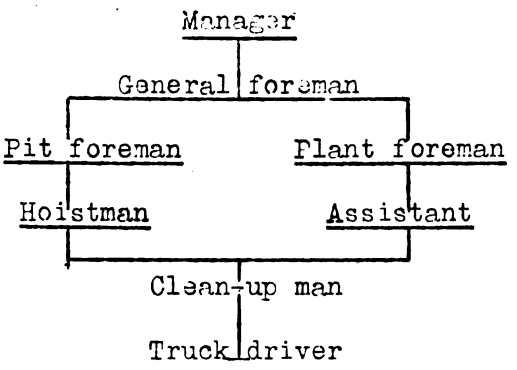
From measurements of the ground excavated and from the shipping weights o the various products sold it is calculated that 70 percent of the bank materia extracted is sold as finished product. Of this, from 70 to 75 percent is sold as glass sand and the remainder as blast sand and for other industrial uses.

PAY SYSTEM, SAFETY METHODS, AND ADMINISTRATION

The base pay is $0.50 per hour, and the men work 8 hours a day and 6 days a week. Safety practices comply in all respects with the California laws, bu there is no first-aid organization. The only lost-time accident in 5 years w a foot injury that kept a man at home for 6 days.

Generated on 2024-09-18 02:42 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Seven men are employed, including the general foreman. An organization chart sented below.



COSTS

While the total production costs of the sand actually shipped have been carefully, there are no detailed figures. To obtain figures that would repre- the costs of the various parts of the operation the totals were divided and ated according to the judgment of the manager and the general foreman. ls they were guided somewhat by detailed cost figures that were kept several ago under different operating conditions. The totals were found each month ding all items chargeable to mining for mining cost and all chargeable to ng to milling cost, and sums of these totals were taken for a period of e production, the results being 16.9 cents for mining and $2 for milling costs.

Mining Costs

Drilling and blasting

	Cents per ton
Labor	4.0
Supervision	1.0
Explosives	1.7
Power	.1
Other supplies	.1
Total	6.9

Loading and transportation

	Cents per ton
Labor	4.0
Supervision	1.0
Power	3.5
Supplies	1.5
Total	10.0

Total cost, per ton of finished product, 16.9 cents per ton.

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Milling Costs

	Cost per ton
Tube-mill grinding	$0.30
Screening	.20
Elevating	.10
Conveying	.05
Scrubbing	.05
Washing	.05
Pumping	.17
Clarifying water	.03
Drying	.40
Hot screening, elevating, and dust removing	.15
Magnetic separation	.15
Storage and trucking, including loading with screen and portable conveyor	.35
Total milling cost	2.00

This cost is per ton of finished product. It is expected that this co and the mining cost will be considerably lower with increased production, a one more man is needed to increase the production 50 percent. The power co remain the same and the supplies will be increased but not in as great pro as the production.

Effort is made to keep the average production at 100 tons per 8-hour d On this basis the man hours per ton would be 0.56. The motor ratings add t 250 horsepower, and on the basis of continuous full-rated load the power co tion would be 2.5 horsepower per ton per day of 8 hours, or 20 horsepower hours per ton.

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY